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## A STARFISH FOUND IN THE WHITEWATER DIVISION OF THE RICHMOND ON BLUE CREEK, ADAMS COUNTY, OHIO.

STEPHEN R. WILLIAMS.

The fossil to be described was not found in place but the shales near by yielded *Byssonychia richmondensis* and *Hebertella sinuata*. The Clinton boundary was located on the same branch of the stream at an elevation (estimated) of forty feet above the point of discovery.

The specimen consists of a part of the disc and of two neighboring arms of a starfish. The arms of this starfish were split vertically along the middle of the ambulacral grooves, separating the pairs of ambulacral plates one from the other. Enough of the disc remained to connect the two half arms together and no more. Fortunately the aboral side of the fragment of disc contains the madreporic body.

The preservation of the fossil is ideal. Except for a certain amount of crushing of the aboral skeletal wall together the skeleton shows much as a similar section of a recent starfish does.

Using the dimensions of the two part-arms and disc as a basis for measurement one can reconstruct the whole animal. I estimate that the starfish when living was approximately four inches in diameter from end to end of the rays on opposite sides.

The remains of the disc and longer arm are 40 m. m. long, the disc and shorter arm 35 m. m.

The pairs of ambulacral pieces which formed the ambulacral grooves in the specimen must have been directly opposite each other. This is indicated both by the shaping of the free ends of each ambulacral piece and by some fragmentary remains on the tips of some of the ambulacral pieces on the longest arm. These are very probably ends broken from the plates which formed the other half of the ambulacral groove.

There are 39 ambulacral plates on one half-arm and 29 on the other. The adambulacral plates, sometimes called the inter-ambulacrals, alternate with the ambulacral plates. There are forty of these on the one arm and twenty-seven on the other. The skeleton is complete along the whole of the inter-ray in which the madreporite lies except for the rows of the movable spines which were based on the adambulacral plates.

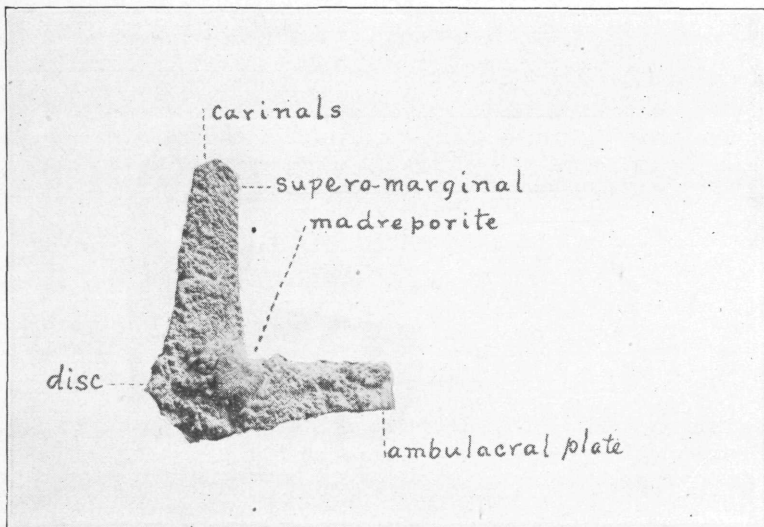


Fig. 1. *Promo-palaeaster dyeri* Meek (?). Natural size, dorsal view part of disc and arms.

There are a number of starfishes described in the publications of the Ohio Geological Survey. Of these *Palaeaster dyeri* Meek, (Plate 4 Vol. 1 part 2 of the *Palaeontology*) resembles most closely the starfish under discussion. The specimen there figured was of a larger animal than this one but as Professor Meek says in his introductory statement, the poor preservation of the parts leaves much to be desired in the description.

The madreporite of *P. dyeri* is trilobate. Its shortest dimension is in the inter-ray and its longest at right angles to this in the horizontal plane. These dimensions are 6 m. m. vertically and 9 m. m. horizontally.

The madreporic body of my specimen shows a trace of this lobation only. The vertical plane dimension is 7 m. m. while the horizontal diameter is 6 m. m. It has quite a different general shape then from the madreporite of *P. dyeri* but the size is almost the same relatively, in view of the sizes of the animals. The appearance of the canals on the surface of the two madreporic bodies is very similar, though the pattern of the lines differs with the shape of the bodies.

The aboral side of the rays and disc, as far as can be made out, is rather less regular than the small portion of the aboral side of *P. dyeri* figured. When one picks out the dorsolateral plates with a lens however many of them are of the same quadrangular type illustrated for *P. dyeri*. There is also a central depression on each of these plates for the insertion of the spine as in *P. dyeri*. It is possible that there are some shorter, slighter pieces which lay between the rows of quadrangular or triangular plates.

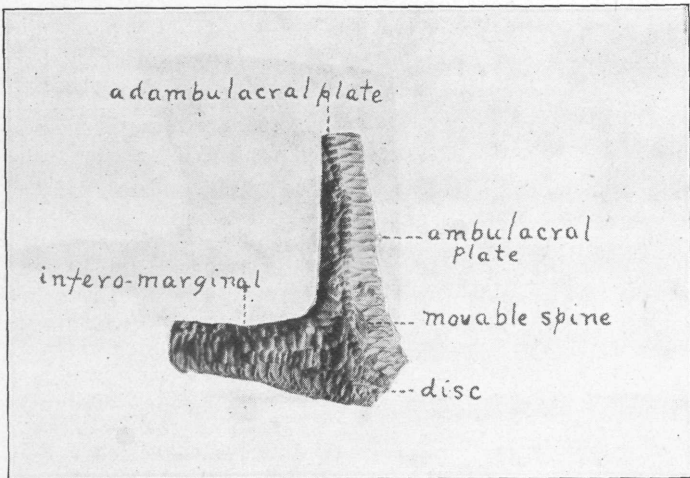


Fig. 2. *Promopalaeaster dyeri* Meek (?) Natural size; ventral view part of disc and arms.

The crushing down of the arch of the aboral skeleton and the mixing the broken spines from the surface in with the plates makes it difficult to state precisely how many rows of dorsolateral plates intervened between the supero-marginal plates and the indistinct carinals which occupy the mid-dorsal line. The modern starfish does not have as many dorsolateral plates as another Richmond starfish, *Palaeaster magnificus* Miller, has. In this respect my specimen seems more like the recent *Asterias*.

The ambulacral plates seen from below are naturally partly covered by adambulacral plates. There are, however, three ambulacral plates at the end of the shorter arm which have lost their adambulacrals. These are 5 m. m. long and a little more than a millimeter wide. The locations of the pores through which the tube feet passed are easily distinguishable. These pores seem to alternate so that each half of the ambulacral groove would present two rows of tube feet. This alternation is only apparent as there is but one tube foot in the opening between two consecutive ambulacral plates and one plate between two successive pores. The device is correlated in the recent starfish, with a more rapid loco-

motion as more tube feet can be crowded into a given length of arm. We can assume that the alternation served the same purpose in the fossil form.

The adambulacral plates are 3 m. m. long by one m. m. thick. Their third dimension, in the vertical plane is about 2 m. m. The aboral ends of these plates fit in between the outer ends of the ambulacral plates. For this reason they are also called the inter-ambulacral plates.

There is evidence that they bore a double row of movable spines on their oral or ventral aspect, but I am not sure that any of these are preserved. There are a few spindle-shaped spines 3 m. m. long, larger near the outer end and tapering gradually to the point of attachment. Spines like these though larger are the ones which Professor Meek calls the movable spines in *P. dyeri*. Other fragments of starfishes of undetermined species lead me to think that these might have been the spines broken from the infero-marginal row of plates and that the regular movable spine was more slender.

The infero-marginal plates are elongate near the disc where the arm is thicker and become more nearly cubical, corresponding to the shape figured for *P. dyeri*, out near the tip of the arm.

Some of these plates show impressions which with some uncertainty I consider to be the remains of pedicellaria around their outer surface. There are also here and there in the spaces between plates isolated structures which might be the larger pedicellaria with the basal plate and two jaws which are found singly in such spaces in recent starfishes.

This specimen shows so many similarities to *Palaeaster dyeri*, the canals of the madreporite, the shapes of the spines, and of the infero-marginal plates that in spite of differences and pending the publication of an authoritative monograph on the Palaeozoic starfishes by Professor Schuchert of Yale University I refer it to this species.

In a letter Professor Schuchert says that the specimen certainly belongs to his genus *Promo-palaeaster* and that it may be *P. wykoffi*, *P. dyeri* or a new species.

In all events and whatever its name, we have in this fragment of a starfish from the Richmond division of the Ordovician sea, millions of years ago, the plates, the pores, the spines and probably the pedicellaria very similar to those which are found in the starfishes of the present day.

If it is in the direct line of ancestors from which our present day *Asterias* has descended it adds one more to the list of forms which have been essentially constant for ages and after once becoming fixed have varied only in very slight degrees around the type.